U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Pinus albicaulis

Common Name:

Whitebark pine

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

04/01/2015

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

Listing Priority Number (LPN) Change

Former LPN:	2
New LPN:	8

___ Candidate Removal

___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

___ Range is no longer a U.S. territory

___ Insufficient information exists on biological vulnerability and threats to support listing

___ Taxon mistakenly included in past notice of review

___ Taxon does not meet the definition of "species"

___ Taxon believed to be extinct

___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 12/09/2008

90-Day Positive:07/20/2010

12 Month Positive:07/19/2011

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**:State(s) information not available

- **US Counties**:County information not available
- **Countries**:Country information not available

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: California, Idaho, Montana, Oregon, Washington, Wyoming
- **US Counties**: Humboldt, CA, Modoc, CA, Shasta, CA, Siskiyou, CA, Tehama, CA, Trinity, CA, Adams, ID, Blaine, ID, Boise, ID, Bonner, ID, Bonneville, ID, Boundary, ID, Butte, ID, Camas, ID, Clark, ID, Clearwater, ID, Custer, ID, Elmore, ID, Fremont, ID, Gem, ID, Idaho, ID, Lemhi, ID, Shoshone, ID, Teton, ID, Valley, ID, Washington, ID, Beaverhead, MT, Broadwater, MT, Carbon, MT, Cascade, MT, Chouteau, MT, Deer Lodge, MT, Flathead, MT, Gallatin, MT, Glacier, MT, Granite, MT, Jefferson, MT, Judith Basin, MT, Lake, MT, Lewis and Clark, MT, Lincoln, MT, Madison, MT, Meagher, MT, Mineral, MT, Missoula, MT, Park, MT, Pondera, MT, Powell, MT, Ravalli, MT, Sanders, MT, Silver Bow, MT, Stillwater, MT, Sweet Grass, MT, Teton, MT, Wheatland, MT, Baker, OR, Clackamas, OR, Deschutes, OR, Douglas, OR, Grant, OR, Hood River, OR, Jackson, OR, Jefferson, OR, Josephine, OR, Klamath, OR, Lake, OR, Lane, OR, Linn, OR, Marion, OR, Union, OR, Wallowa, OR, Wasco, OR, Chelan, WA, Clallam, WA, Ferry, WA, Jefferson, WA, King, WA, Kittitas, WA, Klickitat, WA, Okanogan, WA, Pend Oreille, WA, Pierce, WA, Skagit, WA, Skamania, WA, Snohomish, WA, Stevens, WA, Whatcom, WA, Yakima, WA, Fremont, WY, Hot Springs, WY, Lincoln, WY, Park, WY, Sublette, WY, Teton, WY
- **Countries**:Country information not available

Land Ownership:

Roughly 44 percent of the species' range occurs in the United States, with the remaining 56 percent of its range occurring in British Columbia and Alberta, Canada (COSEWIC 2010, p. iv). In Canada, the majority of the species' distribution occurs on private lands (Achuff 2010, pers. comm.). In the United States, approximately 96 percent of land where the species occurs is federally owned or managed. The majority is located on U.S. Forest Service (USFS) lands (approximately 81 percent, or 4,698,388 hectares (ha) (11,609,969 acres (ac)). The bulk of the remaining acreage is located on National Park Service (NPS) lands (approximately 13 percent, or 740,391 ha (1,829,547 ac)). Small amounts of *Pinus albicaulis* (hereafter called whitebark pine for the purposes of this document) also can be found on Bureau of Land Management (BLM) lands (approximately 2 percent, or 119,598 ha (295,534 ac)). The remaining 4 percent is under non-Federal ownership. The entire range of whitebark pine is approximately 4,887,216 ha (12,076,573 ac).

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Biological Information

Species Description:

Whitebark pine is a tree that is typically 5 to 20 meters (m) (16 to 66 feet (ft)) tall with a rounded or irregularly spreading crown shape. On higher density conifer sites, whitebark pine tends to grow as tall, single-stemmed trees, whereas on open, more exposed sites, it tends to have multiple stems (McCaughey and Tomback 2001, pp. 113–114). Above tree line, it grows in a krummholz form, with stunted, shrub-like growth caused by high winds and cold temperatures (Arno and Hoff 1989, p. 6). This pine species is monoecious (with both male pollen and female seed cones on the same tree). Its characteristic dark brown to purple seed cones are 5 to 8 centimeters (cm) (2 to 3 inches (in.)) long and grow at the outer ends of upper branches (Hosie 1969, p. 42).

Taxonomy:

Whitebark pine is a 5-needled conifer species placed in the subgenus *Strobus*, which also includes other 5-needled white pines. This subgenus is further divided into two sections (*Strobus* and *Parrya*), and under section *Strobus*, into two subsections (*Cembrae* and *Strobi*). The traditional taxonomic classifications placed whitebark pine in the subsection *Cembrae* with four other Eurasian stone pines (Critchfield and Little 1966, p. 5; Lanner 1990, p. 19). However, recent phylogenetic studies (Liston *et al*. 1999, 2007; Syring *et al*. 2005, 2007; as cited in Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2010, p. 4) showed no difference in monophyly (ancestry) between subsection *Cembrae* and subsection *Strobi* and merged them to form subsection *Strobus.* No taxonomic subspecies or varieties of whitebark pine are recognized (COSEWIC 2010, p. 6). Based on this taxonomic classification information, we recognize whitebark pine as a valid species and a listable entity.

Habitat/Life History:

Whitebark pine is a hardy conifer that tolerates poor soils, steep slopes, and windy exposures and is found at alpine tree line and subalpine elevations throughout its range (Tomback *et al*. 2001, pp. 6, 27). It grows under a wide range of precipitation amounts, from about 51 to over 254 cm (20 to 100 in.) per year (Farnes 1990, p. 303). Whitebark pine may occur as a climax species, early successional species, or seral (midsuccessional stage) co-dominant associated with other tree species. Although it occurs in pure or nearly pure stands at high elevations, it typically occurs in stands of mixed species in a variety of forest community types.

Whitebark pine is a slow-growing, long-lived tree with a life span of up to 500 years and sometimes more than 1,000 years (Arno and Hoff 1989, pp. 5–6). It is considered a keystone, or foundation species in western North America where it increases biodiversity and contributes to critical ecosystem functions (Tomback *et al*. 2001, pp. 7– 8). As a pioneer or early successional species, it may be the first conifer to become established after disturbance, subsequently stabilizing soils and regulating runoff (Tomback *et al*. 2001, pp. 10–11). At higher elevations, snow drifts around whitebark pine trees, thereby increasing soil moisture, modifying soil temperatures, and holding soil moisture later into the season (Farnes 1990, p. 303). These higher elevation trees also shade, protect, and slow the progression of snowmelt, essentially reducing spring flooding at lower elevations.

Whitebark pine also provides important, highly nutritious seeds for a number of birds and mammals (Tomback *et al*. 2001, pp. 8, 10). Whitebark pine trees are capable of producing seed cones at 20–30 years of age, although large cone crops usually are not produced until 60–80 years (Krugman and Jenkinson 1974, as cited in McCaughey and Tomback 2001, p. 109). Therefore, the generation time of whitebark pine is approximately 60 years (COSEWIC 2010, p. v). Whitebark pine seed predators are numerous and include more than 20 species of vertebrates including Clark's nutcracker (*Nucifraga columbiana*), pine squirrels (*Tamiasciurus* spp.), grizzly bears (*Ursus arctos*), black bears (*Ursus americanus*), Steller's Jay (*Cyanocitta stelleri*), and pine grosbeak (*Pinicola enucleator*) (Lorenz *et al*. 2008, p. 3). Seed predation plays a major role in whitebark pine population dynamics, as seed predators largely determine the fate of seeds. However, whitebark pine has co-evolved with seed predators and has several adaptations, like masting, that has allowed the species to persist despite heavy seed predation (Lorenz *et al*. 2008, p. 3–4). Masting is the process by which populations synchronize their seed production and provide varying amounts from year to year. During years with high seed production, typically once every 3–5 years in whitebark pine (McCaughey and Tomback 2001, p. 110), seed consumers are satiated, resulting in excess seeds that escape predation (Lorenz *et al*. 2008, pp. 3–4).

Historical Range/Distribution:

The historical distribution of whitebark pine is unknown.

Current Range Distribution:

Whitebark pine occurs in scattered areas of the warm and dry Great Basin but it typically occurs on cold and windy high-elevation or high-latitude sites in western North America. As a result, many stands are geographically isolated (Arno and Hoff 1989, p. 1; Keane *et al*. 2012, p. 13). Its range extends longitudinally between 107 and 128 degrees west and latitudinally between 27 and 55 degrees north (McCaughey and Schmidt 2001, p. 33). The distribution of whitebark pine includes coastal and Rocky Mountain ranges that are connected by scattered populations in northeastern Washington and southeastern British Columbia (Arno and Hoff 1990, p. 268; Keane *et al*. 2012, p. 13). The coastal distribution of whitebark pine extends from the Bulkley Mountains in British Columbia to the northeastern Olympic Mountains and Cascade Range of Washington and Oregon, to the Kern River of the Sierra Nevada Range of east-central California (Arno and Hoff 1990, p. 268). Isolated stands of whitebark pine are known from the Blue and Wallowa Mountains in northeastern Oregon and the subalpine and montane zones of mountains in northeastern California, south-central Oregon, and northern Nevada (Arno and Hoff 1990, p. 268; Keane *et al*. 2012, p. 13). The Rocky Mountain distribution of whitebark pine ranges from northern British Columbia and Alberta to Idaho, Montana, Wyoming, and Nevada (Arno and Hoff 1990, p. 268;

Keane *et al*. 2012, p. 13), with extensive stands occurring in the Yellowstone ecosystem (McCaughey and Schmidt 2001, p. 33). The Wind River Range in Wyoming is the eastern most distribution of the species (Arno and Hoff 1990, p. 268; McCaughey and Schmidt 2001, p. 33) (Figure 1).

Figure 1. - Estimated whitebark pine range distribution (Keane 2000; Little, 1971).

Population Estimates/Status:

Mortality data collected in multiple studies throughout the range of whitebark pine strongly suggests that the species is in range-wide decline. Although the majority of available data was collected in the last several decades, the decline in whitebark pine populations likely began sometime following the 1910 introduction of the exotic disease white pine blister rust. Although we do not have a study that quantifies the rate of decline across the entire range, we conclude that the preponderance of data from the studies listed below and elsewhere in this status review provides evidence of a substantial and pervasive decline throughout almost the entire range of the species.

In Canada, based on current mortality rates, it is anticipated that whitebark pine will decline by 57 percent within 100 years (COSEWIC 2010, p. 19). The value for this anticipated decline is likely an underestimate, as it assumes current mortality rates remain constant into the foreseeable future. Past trends have shown that mortality rates have been increasing over the last several decades (this is discussed in more detail under Factor C, Disease or Predation). The range of mortality rates for whitebark pine in the United States are similar to those in Canada, which suggests that the anticipated rates of decline will be similar.

Distinct Population Segment(DPS):

N/A (Whitebark pine is a plant, and designation of Distinct Population Segments does not apply to this taxonomic group).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Fire and Fire Suppression

Fire is one of the most important landscape-level disturbance processes within high-elevation whitebark pine forests (Agee 1993, p. 259; Morgan and Murray 2001, p. 238; Spurr and Barnes 1980, p. 422), and has been important to perpetuating early seral (successional stage) whitebark pine communities (Arno 2001, p. 82; Shoal *et al*. 2008, p. 20). Without regular disturbance, primarily from fire, these forest communities follow successional pathways that eventually lead to dominance by shade-tolerant conifers such as *Abies lasiocarpa*, *Picea engelmannii*, and *Tsuga mertensiana*, to the exclusion of whitebark pine (Keane and Parsons 2010, p. 57). When fire is present on the landscape, whitebark pine has an advantage over its competitors for several reasons (Keane and Parsons 2010, p. 57). The Clark's nutcracker serves as the main dispersal agent for whitebark pine by caching seeds in disturbed sites, such as burns. Fire creates sites that are suitable for this seed caching behavior and that most importantly contain optimal growing conditions for whitebark pine (Tomback *et al*. 2001, p. 13). In addition, Clark's nutcrackers can disperse seeds farther than the wind-dispersed seeds of other conifers, thereby facilitating whitebark pine succession in burned sites over a broad geographic area (McCaughey *et al*. 1985, Tomback *et al*. 1990, 1993 in Keane and Parsons 2010, p. 58). Additionally, whitebark pine has thicker bark, a thinner crown, and a deeper root system, which allow it to withstand low-intensity fires better than many of its competitors (Arno and Hoff 1990 in Keane and Parsons 2010, p. 58). Historically, fire has been an important factor in maintaining healthy stands of whitebark pine on the landscape.

Fires in the high-elevation ecosystem of whitebark pine can be of low intensity, high intensity, or mixed intensity. These varying intensity levels result in very different impacts to whitebark pine communities. Low-intensity, surface-level ground fires occur frequently under low-fuel conditions. These fires remove small-diameter, thin-barked seedlings and allow large, mature trees to thrive (Arno 2001, p. 82). Low-intensity fires also reduce fuel loads and competition from fire-susceptible conifers, shrubs, and grasses, thereby opening up spaces necessary for the shade-intolerant whitebark pine to regenerate and thus maintain prominence in seral communities (Arno 1986 in Keane *et al*. 1994, p. 215). High-intensity fires occur where high fuel loads, ladder fuels (vegetation below the crown level of forest trees, which allows fire to move from the forest floor to tree crowns), and other compounding conditions result in increased flammability (Agee 1993, p. 258). High-intensity fires, often referred to as stand replacement fires, or crown fires (Agee 1993, p. 16), produce intensive heat, resulting in the removal of all or most of the vegetation from the ground. High-intensity fires begin the process of vegetative succession by opening seed beds that become available for the establishment and development of shade-intolerant species like whitebark pine. High-intensity fires are generally less frequent because it takes longer time intervals to build the large fuel accumulations necessary to promote these types of fires (Agee 1993, p. 258). Mixed intensity fires are most common and result in a mosaic of dead trees, live trees, and open sites for regeneration (Arno 1980, p. 460; Keane 2001a, p. 17). Moderate or mixed severity fires may promote several beneficial restoration objectives: (1) they reduce competition and thereby increase whitebark pine vigor, which enhances resilience to other future disturbances, (2) they create the burned patches that facilitate Clark's nutcracker seed caching, and (3) they create burn perimeters that could act as fuelbreaks to protect surviving rust-resistant trees from future fires because of low fuel loads (Keane *et al*. 2015, pp. 30-31, *in press*). In general, historical fire return intervals in whitebark pine communities have been estimated at between 50 and 300 years (Arno 1980, p. 461).

Beginning in the 1930s, a policy of fire suppression was effectively implemented by the USFS (Arno 1980, p. 460; USFS 2000, p. 1). During the 1970s, in recognition of the importance of wildfire to maintenance of healthy forests, the USFS began a policy shift away from total fire suppression (Cohen 2008, p. 21; USFS 2000, p. 1). However, despite this shift, fire suppression is still carried out, frequently in areas where a threat to human health and safety are anticipated, and we expect this trend of fire suppression to continue into the future (Arno 1980, p. 460; Cohen 2008, p. 21; Keane 2011a, pers. comm.). Fire suppression is expected to continue to impact whitebark pine by preventing fires from spreading from human population centers into areas where whitebark pine occurs.

Fire suppression has had unintended negative impacts on whitebark pine populations (Keane 2001a, entire), due to this shift from a natural fire regime to a managed fire regime. Stands once dominated by whitebark pine have undergone succession to more shade-tolerant conifers (Arno *et al*. 1993 in Keane *et al*. 1994, p. 225; Flanagan *et al*. 1998, p. 307). Once shade-tolerant conifer species become firmly established, the habitat is effectively lost to whitebark pine until a disturbance like fire once again opens the area for whitebark pine regeneration. Shade-tolerant conifer species grow more densely than shade intolerant conifer species like whitebark pine (Minore 1979, p. 3). Denser stands eliminate the open sites that are often used by Clark's nutcracker for seed caching and which are also the sites required to facilitate the regeneration of the shade-intolerant whitebark pine. Additionally, the growth of more homogeneously structured stands with continuous crowns and increased surface fuels has resulted in fires that are larger and more intense (Keane 2001b, p. 175). However, we do not know at what scale these impacts have affected whitebark pine. Determining the total amount of whitebark pine habitat lost to succession rangewide is difficult, as there is seldom a historical baseline for comparison, and the degree of succession is very specific to local conditions (Keane 2011a, pers. comm.).

Conversely, whitebark pine cannot withstand high-intensity fires; during such fires, all age and size classes can be killed. However, newly burned areas provide a seedbed for whitebark pine, and if stands of unburned cone-producing whitebark pine are nearby (i.e., within the range of Clark's nutcracker caching behavior), Clark's nutcrackers will cache those seeds on the burned site, and regeneration is very likely. However, the introduction of the disease white pine blister rust and the current epidemic of the predatory mountain pine beetle (*Dendroctonus ponderosae*) have reduced or effectively eliminated whitebark pine seed sources on a landscape scale (see Factor C, Disease or Predation). Although there is variation in the degree to which specific stands have been impacted, over the range of whitebark pine the widespread incidence of poor stand health from disease and predation, coupled with changes in fire regimes, means that regeneration of whitebark pine, following fire is unlikely in many cases (Tomback *et al*. 2008, p. 20).

Fire and Fire Suppression and the Interaction of Other Factors

Both high-intensity fires and the lack of fire from fire suppression can have negative consequences for whitebark pine. Environmental changes resulting from climate change may expedite the decline of whitebark pine in conjunction with the already observed negative effects of fire suppression; for example, the buildup of surface and canopy fuels can often kill whitebark pine, and increased competition from fir and spruce trees can reduce whitebark pine vigor, affecting cone crops and causing reduced resistance to other disturbances (Keane *et al*. 2015, pp. 30, *in press*) (also see the Climate Change section below). These environmental changes are predicted to increase the number, intensity, and extent of wildfires (Aubry *et al*. 2008, p. 6; Keane 2001b, p. 175). Already, large increases in wildfire have been documented and are particularly pronounced in Northern Rockies forests, which account for 60 percent of documented increases in large fires (Westerling *et al*. 2006, p. 941, 943). Some of the increase has been independent of past management activities and, thus, appears to be a direct result of warming trends in the last several decades (Westerling *et al*. 2006, p. 943). Fire suppression is also expected to negatively interact with white pine blister rust and mountain pine beetle predation. As forests become denser, individual whitebark pine are more vulnerable to white pine blister rust and infestation by mountain pine beetle (see Factor C, Disease and Predation). As mortality from white pine blister rust and mountain pine beetle increase, forest succession to more dense stands of shade tolerant conifers is accelerated (Keane 2011a, pers. comm.).

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8,14, 18,19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

New information available suggests climate change will continue to impact species and ecosystems. The National Climate Assessment (2014, no pagination) concludes that the evidence of human-induced climate change continues to strengthen and impacts are increasing. The consequences of climate change in fragmented landscapes are altering habitat composition and timing of plant development cycles. Higher temperatures and drought stress are contributing to outbreaks of mountain pine beetles that are increasing pine mortality in drier Northwest forests. This trend is projected to continue with ongoing warming. (However, note that as discussed in Factor C, Disease and Predation, we are aware of recent monitoring data that indicates that the current mountain pine beetle epidemic may be waning in many areas.) Despite the apparent reduction of mountain pine beetle-caused mortality in many areas, we expect that mountain pine beetle will remain a threat to whitebark pine in the future. Between now and the end of this century, the elevation of suitable beetle habitat is projected to increase as temperature increases, exposing higher-elevation forests to the mountain pine beetle, but ultimately limiting available area as temperatures exceed the beetles' optimal temperatures. As a result, the proportion of Northwest pine forests where mountain pine beetles are most likely to survive is projected to first increase (27 percent higher in 2001 to 2030 compared to 1961 to 1990) and then decrease (about 49 percent to 58 percent lower by 2071 to 2100). For many tree species, the most climatically suited areas will shift from their current locations, increasing vulnerability to insects, disease, and fire in areas that become unsuitable. Eighty-five percent of the current range of three species that are host to pine beetles is projected to be climatically unsuitable for one or more of those species by the 2060s, while 21 to 38 currently existing plant species may no longer find climatically appropriate habitat in the Northwest by late this century. The National Fish, Wildlife and Plants Climate Adaptation Strategy (2012, pp. 28-30) provides observed and projected ecological changes from the effects of climate change on forests. Increasing temperatures are predicted to increase forest pest damage, change fire patterns, increase the growing season, and increase drought stress. Changes in precipitation can result in longer fire seasons, changes in fire regime, and exacerbate wetter and drier conditions. The increases in drought conditions can result in increased fires and decreased productivity and increased tree mortality. Therefore, the consequences of climate change, if current projections are realized, are likely to exacerbate the existing primary threats to whitebark pine.

Direct habitat loss from climate change is anticipated to occur with current habitats becoming unsuitable for whitebark pine as temperatures increase and soil moisture availability decreases (Hamman and Wang 2006, p. 2783; Schrag *et al*. 2007, p. 8; Aitken *et al.* 2008, p. 103). Habitat loss is expected because (1) temperatures become so warm that they exceed the thermal tolerance of whitebark pine and the species is unable to survive or (2) warmer temperatures favor other species of conifer that currently cannot compete with whitebark pine in cold high-elevation habitats. Whitebark pine is widely distributed and thus likely has a wide range of tolerance to varying temperatures (Keane 2011c, pers. comm.). Therefore, increasing competition from other species that cannot normally persist in current whitebark pine habitats is possibly the more probable climate-driven mechanism for habitat loss.

Given the anticipated loss of suitable habitat, whitebark pine persistence will likely be dependent on the species' ability to either migrate to new suitable habitats, or adapt to changing conditions (Aitken *et al.* 2008, p. 95). Historical (paleoecological) evidence indicates that plant species have generally responded to past climate change through migration, and that adaptation to changing climate conditions is less likely to occur (Bradshaw and McNeilly 1991, p. 12; Huntley 1991, p. 19). Adaptation to a change in habitat conditions as a result of a changing climate is even more unlikely for whitebark pine, given its very long generation time of approximately 60 years (Bradshaw and McNeilly 1991, p. 10). The rate of latitudinal plant migration during past warming and cooling events is estimated to have been on the order of 100 m (328 ft) per year (Aitken *et al*. 2008, p. 96). Given the current and anticipated rates of global climate change, migration rates will potentially need to be substantially higher than those measured in historical pollen records to sustain the species over time. A migration rate of at least a magnitude higher (1,000 m (3,280 ft)) per year is estimated to be necessary in order for tree species to be capable of tracking suitable habitats under projected warming trends (Malcolm *et al.* 2002, entire). Latitudinal migration rates on this scale may significantly exceed the migration abilities of many plant species, including whitebark pine (Malcolm *et al*. 2002, p. 844-845; McKenney *et al.* 2007, p. 941).

Whitebark pine may have an advantage in its ability to migrate given that its seeds are dispersed by Clark's nutcracker. As mentioned above, Clark's nutcrackers can disperse seeds farther than the wind-dispersed seeds of other conifers (McCaughey *et al.* 1985, Tomback *et al.* 1990, 1993 in Keane and Parsons 2010, p. 58). However, migration of whitebark pine to the north may be impeded by the disease white pine blister rust, which is currently present at the northern range limits of whitebark pine (Smith *et al.* 2008, Figure 1, p. 984; Resler and Tomback 2008, p. 165).

Whitebark pine already is typically the first species to establish on cold, exposed high-elevation sites, thus the species could potentially migrate higher in elevation to more suitable habitats. Shifts in the optimum elevation for many high-elevation plant species have already been documented under current warming trends (Lenoir *et al*. 2008, p. 1770). However, elevational migration as a refuge from temperature increase has limits, because eventually, suitable habitat may not be present even on mountaintops due to continuing temperature increases.

Climate change is expected to significantly decrease the probability of rangewide persistence of whitebark pine. Projections from an empirically based bioclimatic model for whitebark pine showed a rangewide distribution decline of 70 percent and an average elevation loss of 333 m (1,093 ft) for the decade beginning in 2030 (Warwell *et al*. 2007, p. 2). At the end of the century, less than 3 percent of currently suitable habitat is expected to remain (Warwell *et al*. 2007, p. 2). Similarly, climate envelope modeling on whitebark pine distribution in British Columbia estimated a potential decrease of 70 percent of currently suitable habitat by the year 2055 (Hamman and Wang 2006, p. 2783). The area occupied by whitebark pine in the Greater Yellowstone Ecosystem also is predicted to be significantly reduced with increasing temperature under various climate change scenarios (Schrag *et al*. 2007, p. 6). Whitebark pine is predicted to be nearly extirpated under a scenario of warming only and warming with a concomitant increase in precipitation (Schrag *et a*l. 2007, p. 7). Climate envelope modeling by the USDA Forest Service using the A2 scenario projects that by 2090, a temperature increase of 9.1 °F (5.1 °C) would cause whitebark pine suitable climate to contract to the highest elevation areas in the northern Shoshone National Forest and Greater Yellowstone Ecosystem or be extirpated (Rice 2012, p. 31). Climate changes may significantly impact whitebark pine in Glacier National Park through the indirect mechanisms of altered distributions of competing tree species and increased fire frequency and fire size (Loehman *et al*. 2010). The above studies all indicate that the area currently occupied by whitebark pine will be severely reduced in the foreseeable future.

We recognize, however, that there are many limitations to such modeling techniques, specifically for whitebark pine. Predicting the future of whitebark pine in western North America is more complex than in the conventional wisdom approach and bioclimatic envelop modeling currently in use. Complex ecophysical spatial models to simulate whitebark pine futures are not available (Keane *et al*. 2015, pp. 92, *in press*). For example, climate envelope models use current environmental conditions in the distribution of the species' range to determine whether similar environmental conditions will be available in the future given predicted climate change. Whitebark pine, however, is a very long-lived species, and current environmental conditions may not closely resemble environmental conditions present when the trees currently on the landscape were established (Keane 2001c, pers. comm.). Additionally, these models also describe current environmental variables in averages taken over large areas. Whitebark pine may experience very different environmental conditions even over a small range as individuals can be separated by thousands of meters (Keane 2011c, pers. comm.).

Climate Change and the Interaction of Other Factors

In addition to direct habitat loss, whitebark pine is expected to experience decrease in population size from synergistic interactions between habitat changes as a result of climate change and other threat factors including altered fire regimes, disease, and predation. Whitebark pine has evolved with fire, and under many conditions, fire is beneficial to the species (see Fire and Fire Suppression above). However, environmental changes resulting from climate change are expected to alter fire regimes resulting in increased fire intervals, increased fire severity, and habitat loss (Westerling *et al*. 2006, p. 943). Damage and mortality over time from white pine blister rust will diminish the current ecological role of whitebark pine in promoting conifer development at the subalpine level, and may confound predictions of upward movement of treeline in response to climate warming (Tomback *et al*. 2014, pp. 407). Due to the loss of whitebark pine, fewer whitebark pine will be available at subalpine level to provide sheltered protection from solar radiation, wind, and extreme temperatures to other conifers. Therefore, survival and growth of other conifers at the subalpine level will be impacted and could inhibit the response of treeline to warming temperatures (Tomback *et al*. 2014, pp. 416).

Whitebark pine also evolved with the predatory native mountain pine beetle (*Dendroctonus ponderosae*). However, the life cycle of the mountain pine beetle is temperature dependent, and warming trends have resulted in unprecedented mountain pine beetle epidemics throughout the range of whitebark pine (the interaction of mountain pine beetle and whitebark pine is discussed further below under Factor C, Predation) (Logan *et al.* 2003, p. 130; Logan *et al.* 2010, p. 896). At epidemic levels, mountain pine beetle outbreaks become stand-replacing events killing 80 to 95 percent of suitable host trees, and in many parts of the whitebark pine range, those levels of mortality have already been reached (Gibson *et al.* 2008, p. 10). Even populations of whitebark pine once considered mostly immune to mountain pine beetle epidemics have been severely impacted; mountain pine beetles have moved into areas previously climatically inhospitable for epidemic-level mountain pine beetle population growth (Carroll *et al*. 2003 in Gibson *et al.* 2008, p. 4; Raffa *et al*. 2008, p. 503; Logan *et al.* 2010, p. 895). As discussed in Factor C, Disease and Predation, recent monitoring data indicates that the current mountain pine beetle epidemic and associated mortality may be waning in many areas. However, given ongoing and predicted environmental changes resulting from global climate change, we expect the expansion of habitat favorable to mountain pine beetle (and mountain pine epidemics) due to higher temperatures and drought stress to continue and therefore to remain a threat into the foreseeable future.

In summary, we analyzed the effects of fire and fire suppression and climate change as related to the present or threatened destruction, modification, or curtailment of the habitat or range of whitebark pine. As identified in our analysis above, fire historically played an integral role in maintaining healthy stands of whitebark pine on the landscape. As a result of past and present fire suppression, forest stands where whitebark pine were once prominent have become dense stands of shade-tolerant conifers. This change in forest composition and structure combined with impacts from climate change has resulted in an increase in the severity, intensity, and frequency of wildfires. We expect that changing fire regimes and fire suppression efforts that create these impacts will continue to affect the species into the foreseeable future. Whitebark pine can regenerate, even following stand-replacing burns, if a seed source is available. However, widespread predation and disease currently impacting whitebark pine are limiting available seed sources, reducing the probability of regeneration following increasing wildfire episodes, and increasing the rate of forest succession.

The pace of predicted climate change will outpace many plant species' ability to respond to the concomitant habitat changes. Whitebark pine is potentially particularly vulnerable to warming temperatures because it is adapted to cool, high-elevation habitats. Therefore, current and anticipated warming is expected to make its current habitat unsuitable for whitebark pine. The rate of migration needed to respond to predicted climate change will be significant (Malcolm *et al*. 2002,

p. 844-845; McKenney *et al*. 2007, p. 941). It is not known whether whitebark pine is capable of migrating at a pace sufficient to move to areas that are more favorable to survival as a result of climate change . It is also not known the degree to which Clark's nutcracker could facilitate this migration. In addition, the presence of significant white pine blister rust infection in the northern range of whitebark pine could serve as a barrier to effective northward migration. Whitebark pine survives at high altitudes already so there is little remaining habitat for the species to migrate to higher elevations in response to warmer temperatures. Adaptation in response to a rapidly warming climate also is unlikely as whitebark pine is a long-lived species. Climate models suggest that climate change is expected to act directly to significantly decrease the probability of rangewide persistence in whitebark pine within the next 100 years. This time interval is less than two generations for this long-lived species. In addition, projected climate change is a significant threat to whitebark pine, because the impacts of climate change interact with other stressors such as mountain pine beetle epidemics and wildfire, resulting in habitat loss and population decline.

Therefore, we conclude that the best scientific and commercial information available indicates that the present or threatened destruction, modification, or curtailment of its habitat or range is a threat to whitebark pine now and in the foreseeable future. Based on the current and ongoing issues identified here, their synergistic effects, and their likely continuation in the future, we conclude that this threat affects the species to such an extent that the species warrants listing under the Act as a threatened or endangered species.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

Commercial Harvest

Whitebark pine is not targeted for commercial timber production in any part of its range (Arno and Hoff 1989, p. 5; COSEWIC 2010, p. 12; Keane *et al*. 2010, p. 30). At lower elevations where whitebark pine occurs with species of commercial interest, some incidental harvest of whitebark pine does take place. The average yearly estimated harvest of whitebark pine in the United States is less than 405 ha (1,000 ac) (Losensky 1990 in Keane *et al*. 2010, p. 30). The best available information does not indicate that harvest is a significant threat to the species or is contributing to the rangewide decline, or decline in any portion of the range of whitebark pine.

Recreational Use

Whitebark pine stands are subject to a variety of nonconsumptive recreational activities including hiking and camping. These activities have the potential to cause negative impacts in localized areas through degradation of habitat in areas experiencing overuse. However, the best available information does not indicate that recreational use is a threat to whitebark pine.

Scientific and Educational Use

Whitebark pine is the subject of many scientific research studies. Currently, there is significant interest in collecting seed cones from individuals identified as being resistant to white pine blister rust. Given the relatively low number of seeds being collected, it is highly unlikely that seed removal is contributing to whitebark pine declines. We have no information indicating that whitebark pine is being used consumptively for educational purposes. Therefore, the best available scientific information does not indicate that scientific and educational uses are a significant threat to whitebark pine.

In summary, at this time, the best available information indicates that overutilization for commercial, recreational, scientific, or educational purposes is not a threat to whitebark pine.

C. Disease or predation:

Disease

White Pine Blister Rust

White pine blister rust is a disease of 5-needled pines caused by a nonnative fungus, *Cronartium ribicola* (Geils *et al*. 2010, p. 153). It was introduced into western North America in 1910 near Vancouver, British Columbia (McDonald and Hoff 2001, p. 198). White pine blister rust initially spread rapidly through maritime and montane environments, which have environmental conditions more conducive to spread of infection, but over several decades, it spread through continental and alpine environments throughout western North America (Geils *et al.* 2010, p. 163). White pine blister rusts rate and intensity of spread is influenced by microclimate and other factors (described below). Therefore, the incidence of white pine blister rust at stand, landscape, and regional scales varies due to time since introduction and environmental suitability for its development. It continues to spread into areas originally considered less suitable for persistence, and it has become a serious threat, causing severe population losses to several species of western pines, including whitebark pine, *P. monticola* (western white pine), and *P. lambertiana* Dougl. (sugar pine) (Schwandt *et al*. 2010, pp. 226…230). Its current known geographic distribution in western North America includes all U.S. States (except Utah, as well as the Great Basin Desert) and British Columbia and Alberta, Canada (Tomback and Achuff 2010, pp. 187, 206). The highest incidence of white pine blister rust infection is in the nortern U.S. and southern Canadian Rocky Mountains.

The white pine blister rust fungus has a complex life cycle: It does not spread directly from one tree to another, but alternates between living primary hosts (i.e., 5- needle pines) and alternate hosts. Alternate hosts in western North America are typically woody shrubs in the genus *Ribes* (gooseberries and currants) but also may include herbaceous species of the genus *Pedicularis* (lousewort) and the genus *Castilleja* (paintbrush) (McDonald and Hoff 2001, p. 193; McDonald *et al.* 2006, p. 73). *Ribes* is widespread in North America and, while most species are susceptible to white pine blister rust infection, they vary in their susceptibility and capability to support inoculum (spores) that are infective to white pines, depending on factors such as habitat, topographic location, timing, and environment (Zambino 2010, pp. 265…268). A widescale Federal program to eradicate *Ribes* from the landscape was conducted from the 1920s to the 1960s. However, due to the abundance of *Ribes* shrubs, longevity of *Ribes* seed in the soil, and other factors, white pine blister rust continued to spread, and pathologists realized that eradication was ineffective in controlling white pine blister rust. White pine blister rust is now pervasive in high-altitude 5-needled pines within most of the western United States (McDonald and Hoff 2001, p. 201).

White pine blister rust progresses through five spore stages to complete each generation: two spore stages occur on white pine (*Pinus* spp.), and three stages occur on an alternate host. The five fungal spore stages require specific temperature and moisture conditions for production, germination, and dissemination. The spreading of spores depends on the distribution of hosts, the microclimate, and the different genotypes of white pine blister rust and hosts (McDonald and Hoff 2001, pp. 193, 202). Local meteorological conditions also may be important factors in infection success, infection periodicity, and disease intensity (Jacobi *et al.* 2010, p. 41).

On white pines, spores enter through openings in the needle surface, or stomates, and move into the twigs, branches, and tree trunk, causing swelling and cankers to form. White pine blister rust attacks seedlings and mature trees, initially damaging upper canopy and cone-bearing branches and restricting nutrient flows; it eventually girdles branches and trunks, leading to the death of branches or the entire tree (Tomback *et al.* 2001, p. 15, McDonald and Hoff 2001, p. 195). White pine blister rust can kill small trees within 3 years, and even one canker can be lethal. While some infected mature trees can continue to live for decades, their cone-bearing branches typically die, thereby eliminating the seed source required for reproduction (Geils *et al*. 2010, p. 156). In addition, the inner sapwood moisture decreases, making trees prone to desiccation and secondary attacks by insects (Six and Adams 2007, p. 351). Death to upper branches results in lower or no cone production and a reduced likelihood that seed will be dispersed by Clarks nutcrackers (McKinney and Tomback 2007, p. 1049). Clark's nutcracker exhibited no breeding in years following low cone production which may suggest a population decline in the future (Schaming 2015, p. 15, 16). Similar to a total loss of cone production, even when cone production is low there could be a loss of regeneration for two reasons: (1) Clarks nutcrackers abandon sites with low seed production and (2) the proportion of seeds taken by predators becomes so high that no seeds remain for regeneration (COSEWIC 2010, p. 25).

Each year that an infected tree lives, the white pine blister rust infecting it continues to produce spores, thereby perpetuating and intensifying the disease. A wave, or massive spreading, of new blister rust infections into new areas or intensification from a cumulative buildup in already-infected stands occurs where *Ribes* shrubs are abundant and when summer weather is favorable to spore production and dispersal. Spores can be produced on pines for many years, and appropriate conditions need to occur only occasionally for white pine blister rust to spread and intensify (Zambino 2010, p. 265). The frequency of wave years depends on various factors, including elevation, geographical region, topography, wind patterns, temperature, and genetic variation in the rust (Kendall and Keane 2001, pp. 222…223).

Because its abundance is influenced by weather and host populations, white pine blister rust also is affected by climate change. If conditions become moister, white pine blister rust will likely increase; conversely, where conditions become both warmer and drier, it may decrease. Because infection is usually through stomates, whatever affects the stomates affects infection rates (Kliejunas *et al.*

2009, pp. 19…20). Stomates close in drought conditions and open more readily in moist conditions. In general, weather conditions favorable to the intensification of white pine blister rust occur more often in climates with coastal influences than in dry continental climates (Kendall and Keane 2001, p. 223). Due to current climate conditions in western North America, white pine blister rust now infects whitebark pine populations throughout all of its range except for the interior Great Basin (Nevada and adjacent areas) (Tomback and Achuff 2010, Figure 1a, p. 187). However, the small uninfected area in the Great Basin accounts for only 0.4 percent of whitebark pine distribution in the United States. The incidence of white pine blister rust is highest in the Rocky Mountains of northwestern Montana and northern Idaho, the Olympic and western Cascade Ranges of the United States, the southern Canadian Rocky Mountains, and British Columbias Coastal Mountains (Schwandt *et al.* 2010, p. 228; Tomback *et al.* 2001, p. 15). The decline of whitebark pine as a result of blister rust infection could diminish the protections whitebark pine provides to other conifers trying to establish at the subalpine level, thereby altering tree development at some Rocky Mountain treelines (Smith-Mckenna *et al*. 2013, pp. 216).

<u>White Pine Blister Rust Infection Rates</u>

Researchers have used various sampling methods to assess the effects of white pine blister rust on whitebark pine and the amounts of infection present; therefore, exact comparisons between studies are not possible. While white pine blister rust occurs throughout almost all of whitebark pine range, not all trees are infected and infection rates vary widely. Furthermore, it can be difficult to detect white pine blister rust, especially if cankers occur on gnarled canopy branches where infections may remain undetected (Rochefort 2008, p. 294). However, despite slight differences in sampling methods general trends can be identified from the published literature (Schwandt *et al*. 2010, p. 228). Trends strongly indicate that white pine blister rust infections have increased in intensity over time and are now prevalent even in trees living in cold, dry areas originally considered less susceptible (Tomback and Resler 2007, p. 399; Smith-Mckenna *et al*. 2013, pp. 224), such as the Greater Yellowstone Ecosystem (Table 1).

Table 1.Percentage of live trees with blister rust infection on plots/transects from recent surveys (adapted from Schwandt 2006, Table 1, p. 5).

GEOGRAPHIC REGION - NUMBER OF REPORTS [REFERENCE]	RANGE OF INFECTION (%)	MEAN (%)
British Columbia (rangewide) [Campbell and Antos 2000]	0 - 100	50.0
British Columbia (rangewide) [Zeglen 2002]	11 - 52.5	38.0
Northern Rocky Mountains (United States and Canada) [Smith *et al.* 2006]	0 - 100	43.6
Selkirk Mountains, northern Idaho - 5 stands [Kegley *et al.* 2004]	57 - 81	70.0
Colville National Forest, northeast Washington - 2 reports [Ward *et al.* 2006]	23 - 44	41.4
Greater Yellowstone Ecosystem [2005]	0 - 100	25.0
Intermountain West (Idaho, Nevada, Wyoming, California) [Smith and Hoffman 2000]	0 - 100	35.0
Blue Mountains, northeast Oregon [Ward *et al.* 2006]	0 - 100	64.0
Coast Range, Olympic Mountains, Washington - 2 reports [Ward *et al.* 2006)	4 - 49	19.0
Western Cascades, Washington and Oregon - 6 reports (Ward *et al.* 2006]	0 - 100	32.3
Eastern Cascades, Washington and Oregon - 13 reports [Ward *et al.* 2006]	0 - 90	32.3
Coastal Mountains, southwest Oregon [Goheen *et al.* 2002]	0 - 100	52.0
California, Statewide [Maloney and Dunlap 2006]	0 - 71	11.7

While numerous studies have reported the incidence of white pine blister rust on whitebark pine and subsequent mortality, fewer have reported on rates of change. In parts of the Greater Yellowstone Ecosystem, results from repeated white pine blister rust surveys indicate that the proportion of infected whitebark pine (greater than 1.4 meters tall) has remained relatively static at an estimated 20-30 percent over the survey period from 2004 to 2011 (Greater Yellowstone Whitebark pine Monitoring Working Group 2014b, p. 11, 13, 16). This apparently static infection rate likely reflects a combination of several factors including 1) some individual whitebark pine show genetic resistance to white pine blister rust and 2) prevailing environmental conditions have not been favorable for the spread of blister rust in the areas surveyed (Mahalovich 2014, p. 12). However, as stated previously, favorable conditions need to occur only occasionally for white pine blister rust to eventually spread and intensify (Zambino 2010, p. 265). This fact is important to note, given that blister rust maintains a significant presence in the area with 81 percent (2004-2007) and 86 percent (2008-2011) of the transects surveyed containing the pathogen (Greater Yellowstone Whitebark pine Monitoring Working Group 2014b, p. 11). In addition, by the end of the 2011 monitoring period, 20 percent of blister rust infections occurred on the trunk of infected trees. This is more of a concern than infection in the canopy because trunk infection compromises the longevity and reproduction of those trees (Greater Yellowstone Whitebark pine Monitoring Working Group 2014b, p. vii, 18). Tomback *et al*. (2014, pp. 416) recently studied the Rocky Mountain Front in Montana and found blister rust infections and mortality in treeline and subalpine whitebark pine , which can disrupt the important microsite protections that whitebark pine provides for other conifers at high elevations.

Additional information on infection trends has been reported for Canada. In the Canadian Rockies, stands surveyed 2003 to 2004 had an overall infection level of 42 percent and 18 percent mortality. These were remeasured in 2009 and found to have increased to 52 percent infection and 28 percent mortality (Smith *et al*. 2010, p. 67; Smith *et al*. 2013, p. 90). Of the eight plots that were surveyed three times, the proportion of infected whitebark pine was 43 percent (1996), 70 percent (2003) and 78 percent (2009) while mortality increased from 26 percent to 65 percent (Smith *et al*. 2013, p. 90). This information indicates both infection rates and mortality increased substantially in Canada. Infection and mortality from white pine blister rust were present in all stands, with the highest levels occurring in the southern portions of the study area. The high mortality and infection levels, high crown kill, and reduced regeneration potential in the southern portion of their study area suggests that long-term persistence of whitebark pine is unlikely (Smith *et al*. 2008, p. 982).

Importantly, whitebark pine infected with white pine blister rust has increased in all regions of the Canadian Rockies, where it ranged from 7 to 70 percent in 2003…2004 to 13 to 83 percent in 2009 (COSEWIC 2010, p. viii and Table 4, p. 19). Further, based on current mortality rates (including all mortality factors), the estimated whitebark pine population decline within 100 years is 78 percent in the Canadian Rockies, 97 percent in Waterton Lakes National Park, and 57 percent for all of Canada (COSEWIC 2010, p. viii and Table 4, p. 19). Whitebark pine was designated in April 2010 as endangered in Canada due to the high risk of extirpation. Based on these studies showing rates of change in the United States and Canada as well as the plethora of infection percentage data, we conclude that the trend of white pine blister rust infection is increasing rangewide.

<u>Genetic Investigations of White Pine Blister Rust Resistance and Virulence</u>

Genetic research and development on white pine blister rust resistance may offer the best long-term prospect for control (Kinloch, Jr. 2003, p. 1045); however, understanding of the dynamics of resistance to white pine blister rust, as well as its virulence and evolution, is incomplete (Schwandt *et al*. 2010, p. 241; Richardson *et al.*2010, p. 321). In whitebark pine, some rust resistance has been documented on the landscape and in seeds, suggesting some level of heritable resistance (Hoff *et al.* 2001, p. 350; Mahalovich *et al.* 2006, p. 95; Maholovich 2015). A limited number of whitebark pine rust-resistance trials, in which seedlings are grown from rust-resistant seeds under varying conditions, have produced progeny seedlings with a range of resistance levels from 0 percent resistance in some areas to more than 40 percent resistance in other areas (Sniezko 2011, pers. comm.). Testing continues on seedlings from throughout the species range, primarily from Oregon and Washington (Sniezko 2015). Some of the highest levels and frequency of blister rust resistance occur in the Pacific Coast portion of the species range (Sniezko 2015). In the northwestern United States, where white pine blister rust has infected trees for as long as 60 years or more, whitebark pine rust-resistance trial results have indicated a trend of increasing resistance levels from southern Oregon north to Mount Rainier in Washington (Sniezko 2011, pers. comm.). In the inland west, blister rust resistance screenings are continuing (Mahalovich 2015). Active research and management to identify and use genetic resistance to blister rust, which is present at a low frequency within western white pine and whitebark pine populations, offers the best potential for successful long-term reforestation or restoration (Sniezko 2014, pers. comm; Kegley et al. 2012, p. 315). However, despite some encouraging results in limited trials, efforts are in early stages. Further, effective rust-resistance breeding programs to develop whitebark pine trees for planting will likely take decades (Hoff et al. 2001, p. 359), and their outcomes are uncertain but promising.

Even if genetic resistance is identified in whitebark pine, hybridization between different white pine blister rust populations or mutations within populations could result in genetic variation in virulence, creating a new assortment of genes and behaviors (McDonald and Hoff 2001, p. 210). The potential for development of new white pine blister rust strains between eastern and western North America with greater virulence, fitness, and aggressiveness is currently unknown (Schwandt *et al*. 2010, p. 241). While North American populations of white pine blister rust have low genetic diversity and differentiation overall (Richardson *et al.* 2010, p. 316), rust genotypes with specific virulence to major resistance genes currently exist in some local populations at high frequencies (Kinloch, Jr. 2003, p. 1044). The reintroduction of white pine blister rust from goods imported from abroad also poses a serious danger to genetic selection and breeding programs. In Asia, white pine blister rust exists with different alternate host affinities and also may contain additional genes with wider virulence (Kinloch, Jr. 2003, pp. 1044, 1046).

Management and Restoration Efforts

Most current management and research focuses on producing white pines with inherited resistance to white pine blister rust, but also includes natural regeneration and silvicultural treatments, such as appropriate site selection and preparation, pruning, and thinning (Zeglen *et al.* 2010, p. 347). Genetic management of white pine blister rust is actively conducted for several 5-needled white pine species breeding programs (Sniezko 2015, Mahalovich 2015), including the USFS resistance screening programs for whitebark pine.

High-elevation pines such as whitebark pine also present management challenges to restoration due to remoteness, difficulty of access, and conflicting wilderness values (wilderness values are discussed in more detail under Factor D) (Schwandt *et al.* 2010, p. 242). Furthermore, the vast scale at which planting rust-resistant trees would need to occur will make it challenging to restore whitebarkpine throughout its range. For example, approximately 5 percent of the historical distribution of the commercial species *Pinus monticola* (western white pine) was planted with resistance-improved stock between 1976 and 1996; however, the rates of planting have declined since then, and given current rates of planting, 60 years would now be required to plant an additional 5 percent (Schwandt *et al*. 2010, pp. 241…242). Therefore, current planting efforts appear to be insufficient to restore whitebark pine on a scale large enough to ensure its continued viability.

Model Predictions

Several models have been developed to predict residence times of white pine blister rust infection and long-term persistence of whitebark pine. Ettl and Cottone (2004, pp. 36…47) developed a spatial stage-based model to examine whitebark pine persistence in the presence of heavy white pine blister rust infections in Mt. Rainier National Park. They predicted median time to quasi extinction (population of less than 100 individuals) is 148 years, which represents approximately two to three generations of whitebark pine. The most recent modeling effort by Hatala *et al*. (2011) is the first known study of the rate of blister rust progression and residence time in whitebark pine. Their analysis compares four possible white pine blister rust dynamic infection models in whitebark pine at the ecosystem scale (Greater Yellowstone Ecosystem) and predicts that on average, whitebark pine trees live with white pine blister rust infection for approximately 20 years before succumbing to the disease. Their model also predicted that, within all their study sites, an average of 90 percent of the trees would be infected with white pine blister rust by the year 2013, while two other models calculated a 90 percent infection level within sites by the years 2026 and 2033. These results predict white pine blister rust will continue to spread within whitebark pine in 10…20 years to a level where almost all trees will be impacted. Notably, model results from Field *et al*. (2012, pp. 180) show it is possible for high elevation white pine populations to tolerate moderate levels of white pine blister rust infection as long as seedling recruitment is maintained and stands are not simultaneously suppressed by other competing tree species or mortality (i.e. mountain pine beetle). Based on these modeling results, we conclude that, in addition to white pine blister rust occurring across almost the entire range of whitebark pine, individual sites with white pine blister rust infection will continue to increase and intensify, ultimately resulting in stands that are no longer viable and potentially facing extirpation.

Predation (Herbivory)

Insect Predation

Whitebark pine trees are fed upon by a variety of insects; however, none has had a more widespread impact than the native mountain pine beetle (*Dendroctonus ponderosae* Hopkins). The mountain pine beetle is recognized as one of the principal sources of whitebark pine mortality (Raffa and Berryman 1987, p. 234; Arno and Hoff 1989, p. 7). Mountain pine beetles are true predators on whitebark pine and other western conifers because, to successfully reproduce, the beetles must kill host trees (Logan and Powell 2001, p. 162; Logan *et al.* 2010, p. 895). Upon locating a suitable host (i.e., large diameter tree with greater resources for brood production success), adult female mountain pine beetles emit pheromones that attract adult males and other adult females to the host tree. This attractant pheromone initiates a synchronized mass attack for the purpose of overcoming the host trees defenses to mountain pine beetle predation. Once a tree has been fully colonized, the beetles produce an anti-aggregation pheromone that signals to incoming beetles to pass on to nearby unoccupied trees. Almost all host trees, even stressed individuals, will mount a chemical defense against these mass attacks. However, given a sufficient number of beetles, even a healthy trees defensive mechanisms can be exhausted (Raffa and Berryman 1987, p. 239). Following the pheromone-mediated mass attack, male and female mountain pine beetles mate in the phloem (living vascular tissue) under the bark of the host tree. Females subsequently excavate vertical galleries where they lay eggs. Larvae hatched from these eggs feed on the phloem, pupate, and emerge as adults to initiate new mass attacks of nearby su itable trees (Gibson *et al.* 2008, p. 3). Mountain pine beetle development is directly controlled by temperature. The entire mountain pine beetle life cycle (from egg to adult) can take between 1 and 2 years depending on ambient temperatures. Warmer temperatures promote a more rapid development that facilitates a 1-year life cycle (Amman *et al.* 1997, p. 4; Gibson *et al*. 2008, p. 3).

Beetle activity in the phloem mechanically girdles the host tree, disrupting nutrient and water transport and ultimately killing the host tree. Additionally, mountain pine beetles carry on their mouthparts symbiotic blue-stain fungi, which are introduced into the host tree. These fungi also inhibit water transport and further assist in killing the host tree (Raffa and Berryman 1987, p. 239; Keane *et al.* 2010, p. 34).

Mountain pine beetles are considered an important component of natural forest disturbance (Raffa *et al*. 2008, p. 502; Bentz *et al.* 2010, p. 602). At endemic or …natural levels, mountain pine beetle remove relatively small areas of trees, changing stand structure and species composition in localized areas. However, when conditions are favorable, mountain pine beetle populations can erupt to epidemic levels and create stand-replacing events that kill 80 to 95 percent of suitable host trees (Keane *et al.* 2010, p. 34). Such outbreaks are episodic, can have a magnitude of impact on the structure of western forests greater than wildfire (the other major component of natural forest disturbance), and are often the primary renewal source for mature stands of western pines (Hicke *et al*. 2006, p. 1; Raffa *et al*. 2008, pp 502-503; Six *et al.* 2014, pp. 104). Mountain pine beetle outbreaks typically subside only when suitable host trees are exhausted or temperatures are sufficiently low to kill larvae and adults (Gibson *et al.* 2008, p. 2).

The range of mountain pine beetle completely overlaps with the range of whitebark pine, and mountain pine beetle epidemics affecting whitebark pine have occurred throughout recorded history (Keane *et al.* 2010, p. 34). Recent outbreaks occurred in the 1930s, 1940s, and 1970s, and numerous …ghost forests of dead whitebark pine still dot the landscape as a result (Arno and Hoff 1989, p. 7; Ward *et al*. 2006, p. 8).

Despite recorded historical impacts to the species, whitebark pine has not been considered an important host of mountain pine beetle in the past. Unlike the lower elevation sites occupied by mountain pine beetles primary hosts, *P. contorta* Douglas (lodgepole pine) and *P. ponderosae* (ponderosa pine), the high-elevation sites occupied by whitebark pine typically have been climatically inhospitable to mountain pine beetle (Logan and Powell 2001, p. 161). At the low temperatures typical of high-elevation sites, mountain pine beetle mostly experience a 2-year life cycle, which is not favorable to epidemic outbreaks (i.e., eruptive population growth). Warmer temperatures promote a 1-year life cycle, which facilitates the synchronized mass attacks important in overcoming host tree defenses (Logan and Powell 2001, p. 167).

However, unlike previous epidemics, the current mountain pine beetle outbreak has had a significant rangewide impact on whitebark pine (Logan *et al*. 2003, p. 130; Logan *et al*. 2010, p. 896). The reported mortality rates of mostly mature trees (i.e. large-diameter trees) have been as high as 96 percent (Gibson *et al*. 2008, p. 9). In 2007 alone, whitebark pine trees on almost 202,342 ha (500,000 ac) were killed (4 percent of the range). At the time, this was the highest recorded mountain pine beetle mortality ever reported for whitebark pine (Gibson *et al.* 2008, p. 2). The number of acres with mountain pine beetle-killed whitebark pine trees continued to increase significantly rangewide, and in 2009 whitebark pine trees on an estimated 809,371 ha (2,000,000 ac) were killed (16 percent of the range) (Service 2010). The Greater Yellowstone whitebark pine Monitoring Working GroupÃ (2015a, pp. 16) monitoring program captured a shift in magnitude from endemic levels to epidemic levels of mountain pine beetle infestation.

Trends of environmental effects from climate change have provided the favorable conditions necessary for the current, unprecedented mountain pine beetle epidemic in high-elevation communities across the western United States and Canada (Logan and Powell 2001, p. 167; Logan *et al.* 2003, p. 130; Raffa *et al*. 2008, p. 511). Warming trends have resulted in not only intensified mountain pine beetle activity in high-elevation whitebark pine forests, but have resulted in mountain pine beetle range expansion into more northern latitudes and higher elevations (Logan and Powell 2003, p. 131; Carroll *et al.* 2003 in Gibson *et al*. 2008, p. 4; Raffa *et al.* 2008, p. 503; Logan *et al.* 2010, p. 895). Winter temperatures are now warm enough for winter survival for all mountain pine beetle life stages and for maintenance of the 1-year life cycle that promotes epidemic mountain pine beetle population levels (Buotte 2014, pers. comm.; Bentz and Schen-Langenheim 2007, p. 47; Logan *et al.* 2010, p. 896). Along with warmer winter conditions, summers have been drier, with droughts occurring through much of the range of whitebark pine (Bentz *et al.* 2010, p. 605). More recent research compares the Rocky Mountains of Idaho, Montana, Wyoming and northern Colorado, where deep winter freezes typically kill about half of all mountain pine beetles, to southern and coastal forests (Weed *et al*. 2015, pp. 14-15). For southern and coastal forests, the winters dating back to 1980 were never cold enough to kill the pests, so other factors may have been at play to explain why the beetles have killed some 90 million acres of pine trees over the past 15 years.

Mountain pine beetles frequently target drought-stressed trees, which are more vulnerable to attack as they are less able to mount an effective defense against even less dense mass attacks by mountain pine beetles (Bentz *et al.* 2010, p. 605). Given ongoing and predicted environmental effects from climate change, we expect the expansion of habitat favorable to mountain pine beetle (and mountain pine epidemics) to continue into the foreseeable future.

The current mountain pine beetle epidemic began in the late 1990s and continues to be an important source of mortality for whitebark pine (Shelly 2014, pers. comm.; Macfarlane *et al*. 2013, pg. 434; Mahalovich 2013, p. 21). However, we are aware of recent monitoring data that indicates that the current epidemic may be waning in many areas (Shelly 2014, pers. comm.; Hayes 2013, p.3, 41, 42, 54; Bower 2014, p. 2; Alberta Whitebark and Limber Pine Recovery Team 2014, p. 18).

In Montana and Idaho, whitebark pine mortality of trees from 2003-2007 was low (40,468 ha …60,702 ha per year) (100,000 ac …150,000 ac per year) (Figure 2), (Shelley 2014, pers. comm). Mortality peaked from 2008-2010 (80,937 …161,874 ha per year) (200,000 ac - 400,000 ac per year) (Shelley 2014, pers. comm). Significant decreases in mortality occurred 2011-2013 (less than 20,234 ha (50,000 ac) per year) (Shelley 2014, pers. comm.).

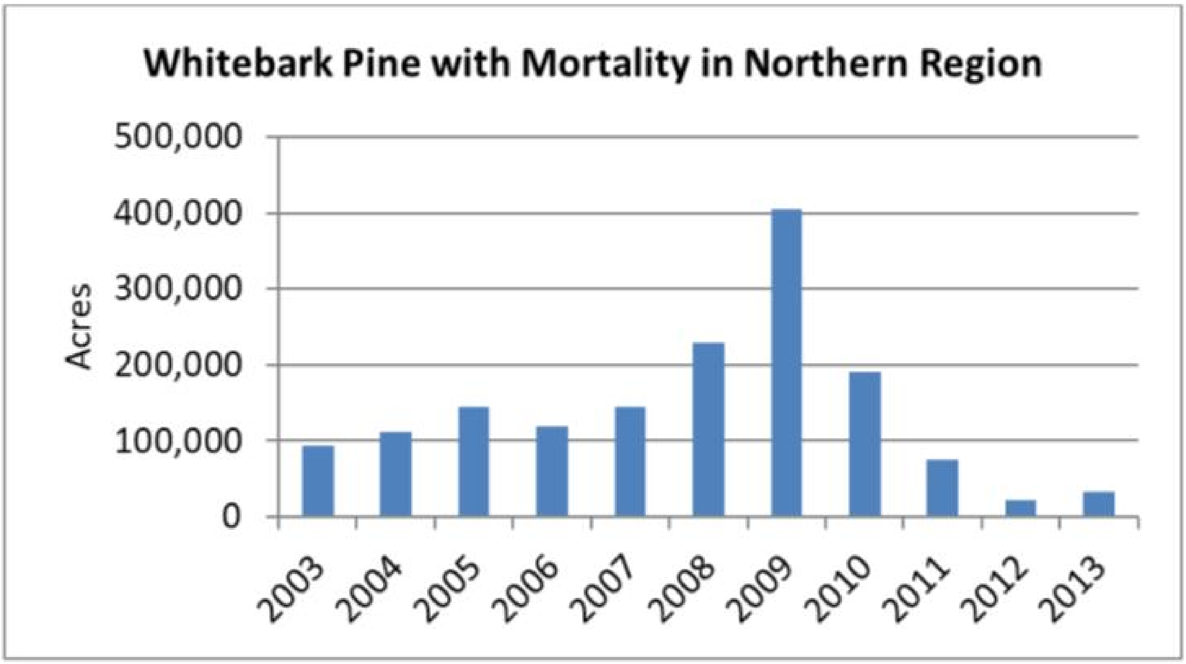

Figure 2. Whitebark pine mortality in acres 2003-2013, US Forest Service Northern Region (Montana and Idaho) (Shelley 2014).

In 2012, aerial surveys showed that the area of forested stands in western Montana with mountain pine beetle-caused mortality was lower (9,052 ha) (22,369 ac) than in 2011 (30,460 ha) (75,269 ac) and 2010 (77,421 ha) (191,312 ac) (Hayes 2013, pp. 3, 39, 41, 42, 54). This observed mortality included high-elevation five needle pine trees, which includes whitebark pine and small amounts of limber pine (*Pinus flexilis*) (Hayes 2013, pp. 3, 39, 41, 42, 54). Aerial detection surveys were also conducted in 2013 and 2014 over all forested areas with whitebark pine and other conifers in Oregon and Washington (Bower 2014, p. 2). In 2013, 2,384 ha (5,891 ac) were affected by mountain pine beetle, but in 2014, less area was affected (1,687 ha (4,170 ac)) (Bower 2014, p. 2). Overall, mortality of whitebark pine due to mountain pine beetle has declined in Oregon and Washington (Bower 2014, p. 2). Currently, mountain pine beetle population levels are very low in the southwest part of Alberta and most infestations are outside of the range of whitebark pine (Alberta Whitebark and Limber Pine Recovery Team 2014, p. 18). However, we have no data from previous years for comparison. It is estimated that fewer than 5,000 whitebark pine trees have been killed by mountain pine beetle in Alberta during the current outbreak. As part of the Government of Albertas mountain pine beetle management program, any whitebark pine detected attacked by mountain pine beetle was felled and burned.

This reduction in beetle-caused mortality over a majority of the range is expected. Significant numbers of whitebark pine have already been killed leaving less food (live trees) available for mountain pine beetles to continue reproducing at epidemic levels. Despite the apparent reduction of mountain pine beetle-caused mortality in many areas, we expect that mountain pine beetle will remain a threat to whitebark pine in the future. We anticipate that ongoing warming trends will continue to allow expansion of beetle populations into previously unhospitable areas and to provide environmental conditions favorable for future beetle outbreaks. While recovery of whitebark pine in areas hit by mountain beetle is possible over time, it is not certain to occur, because recovery depends on a number of factors such as future climatic conditions, severity of future outbreaks of white pine blister rust, adequate seed dispersal by Clarks nutcracker, and success of conservation efforts.

Current management and research continue to explore methods to control mountain pine beetle mainly with the use of the pesticide Carbaryl and the antiaggregation pheromone called Verbenone. Both methods can be effective for limited time periods (Progar 2007, p. 108). However, use of either control method may be prohibitively expensive and challenging given the scale of mountain pine beetle outbreaks (i.e., millions of acres) and the inaccessibility of much of whitebark pine habitat. Currently these methods are mostly being suggested for use in targeted protection of high-value trees (e.g. individuals resistant to white pine blister rust, stands in recreational areas) rather than as a large-scale restoration tool (Keane *et al.* 2010, p. 94). Therefore, these control methods are not currently sufficient to protect the species as a whole from mountain pine beetle predation. However, as explained above, mountain pine beetle predation is no longer occurring at an epidemic level. Although no longer having current widespread impacts, mountain pine beetle epidemics are cyclical, and given climatic conditions that are increasingly favorable to the beetle, we anticipate future epidemics will be more frequent and severe.

Synergistic Interactions between Disease and Predation

White pine blister rust and mountain pine beetle act both individually and synergistically to pose a threat to whitebark pine rangewide. Mountain pine beetle will preferentially attack whitebark pine infected with, and weakened by, white pine blister rust (Six and Adams 2007, p. 351; Bokino and Tinker 2012, p. 38). Whitebark pine trees that were selected as hosts by mountain pine beetle exhibited significantly greater blister rust severity than trees that were not selected by mountain pine beetle in the Greater Yellowstone Ecosystem (Bokino and Tinker 2012, p. 31). This preference results in increased susceptibility of whitebark pine to mountain pine beetle-caused mortality. Mountain pine beetles and white pine blister rust also interact in other ways that pose a threat to whitebark pine regeneration and persistence. Mountain pine beetles preferentially target large mature trees. As a result, large trees are removed from populations, leaving smaller trees for regeneration in a less competitive environment. Unfortunately, white pine blister rust is not selective and infects all age and size classes of whitebark pine. Thus, in the current environment that contains epidemic levels of mountain pine beetle and a nearly ubiquitous presence of white pine blister rust, whitebark pine that have escaped mountain pine beetle mortality are still susceptible to white pine blister rust, and the possibility of regeneration following mountain pine beetle epidemics is jeopardized. Conversely, the small percentage of whitebark pine individuals that are genetically resistant to white pine blister rust, and thus critical to species persistence, are still vulnerable to mountain pine beetle attack.

White pine blister rust and mountain pine beetle further impact the probability of whitebark pine regeneration because both act to severely decrease seed cone production. White pine blister rust does this by killing cone-bearing branches, such that even if the tree itself remains alive for some time, seed production is compromised. Mountain pine beetles decrease seed production by targeting and killing larger trees, which are the main trees that bear cones. A severe reduction in seed production has the potential to limit the effectiveness of the masting strategy employed by whitebark pine (see Taxonomy and Life History), such that the proportion of seeds taken by seed predators will eventually become too high to allow regeneration (Rapp 2013, p. 1349). Additionally, severe seed reduction disrupts the relationship between whitebark pine and Clarks nutcracker (Barringer *et al*. 2012, pg. 10). Clarks nutcrackers eventually abandon whitebark pine stands when seed production is too low (McKinney *et al*. 2009, p. 599).

Limited research has focused on detecting amounts of whitebarkpine regeneration. Most remaining high-elevation whitebark pine stands in the U.S. Intermountain West that are climax communities have little regeneration (Kendall and Keane 2001b, p. 228). In contrast, new and advanced whitebark pine regeneration was documented on the majority of plots in southwestern Montana and eastern Oregon, indicating that the Wallowa and Pioneer Mountains sites seem to be more vigorous and to be regenerating better than sites farther north in the Rockies (Larson 2007, pp. 16…18). However, there is much whitebark pine site variability and the regeneration on some of these sites was preceded by a particularly large cone crop in 2006. In addition, as seedlings grow, their increased foliage surface area becomes a larger target for infection by white pine blister rust spores (Tomback *et al*. 1995, p. 662). Therefore, despite observed regeneration, the level of effective regeneration (i.e., seedlings that actually reach a reproductive age) is questionable given the high incidence of white pine blister rust currently on the landscape. We conclude that whitebark pine regeneration will generally be less successful in the future than it has been in the past.

In summary, disease in the form of white pine blister rust and predation from mountain pine beetle are contributing, individually and in combination, to the decline of whitebark pine rangewide. White pine blister rust is now ubiquitous on the landscape; millions of acres (hectares) of whitebark pine have been infected, and that number is increasing yearly. , However, the most recent mountain pine beetle epidemic is currently waning. At its peak in the late 2000s, the epidemic occurred at unprecedented levels, causing mortality in millions of acres (hectares) of whitebark pine. Because the beetle epidemic is subsiding, we expect impacts from synergistic interactions between mountain pine beetle and disease to be measurably reduced. Importantly for the persistence of the species, reproductive individuals that show genetic resistance to blister rust now have a higher probability of survival and reproduction in the absence of significant mountain pine beetle mortality.

There is no known way to control or reduce or eliminate either threat at this time, particularly at the landscape scale needed to effectively conserve this species. Thus, we expect both disease and predation to continue to impact whitebark pine. The subsidence of the most recent mountain pine beetle epidemic, however, means, predation will play a smaller role in the near future. On the basis of a review of the best scientific and commercial information available concerning present threats to whitebark pine from white pine blister rust and mountain pine beetle, their synergistic effects, and their likely continuation in the future, we conclude that disease and predation is a threat to whitebark pine.

D. The inadequacy of existing regulatory mechanisms:

Federal Laws and Regulations

More than 96 percent of the distribution of whitebark pine in the contiguous United States is federally owned or managed (Service 2011, p. 1), 34 percent of which is designated as wilderness.

The Wilderness Act of 1964

The USFS and other Federal agencies manage lands designated as wilderness areas under the Wilderness Act of 1964 (16 U.S.C. 1131 1136). Considerable amounts of whitebark pine occur within wilderness areas managed by the USFS and NPS (31 percent and 2.5 percent of the total United States distribution, respectively) (Service 2011, p. 1) and, therefore, are afforded protection from direct loss or degradation by some human activities (e.g. commercial timber harvest, road construction, some fire management actions).

Conversely, the regulations covering wilderness areas on Federal lands also may impede or restrict potential activities necessary for restoring whitebark pine (Aubry 2011, pers. comm.; Reinhart 2010, pers. comm.). Currently, there are inconsistent policy interpretations across wilderness areas (Schwandt 2011, pers. comm.). Consequently, Federal agencies are engaged in ongoing discussions regarding whether restoration of whitebark pine in wilderness areas is appropriate, and if so, what types of actions would be allowed. Recently, a decision was made to not plant seedlings of whitebark pine in wilderness in Washington State on USFS lands (Bower 2015, pp. 7, App. C). Taking action on whitebark pine restoration in wilderness areas could compromise the untrammeled value of wilderness, but not taking action may compromise the naturalness value of wilderness by allowing the extirpation of a keystone species. If restoration actions are not restricted under the Wilderness Act, they would likely be limited (Reinhart 2011, pers. comm.). To date, limited surveys and monitoring of whitebark pine trees and cone collecting for seeds have occurred in wilderness areas (Schwandt 2011, pers. comm.; Bower 2015, pp. 1, 7, App. B). While the Wilderness Act may allow for some restoration actions, it does not directly address or alleviate the threats of environmental effects resulting from climate change, white pine blister rust, mountain pine beetle, or fire suppression. The Wilderness Act does influence some fire management actions, which are described under Federal Wildland Fire Management Policies, Plans, and Guides below.

National Environmental Policy Act of 1970

All Federal agencies are required to adhere to the National Environmental Policy Act (NEPA) of 1970 (42 U.S.C. 4321 *et seq*.) for projects they fund, authorize, or carry out. The Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1500,1518) state that agencies shall include a discussion on the environmental impacts of the various project alternatives (including the proposed action), any adverse environmental effects that cannot be avoided, and any irreversible or irretrievable commitments of resources involved (40 CFR 1502). Additionally, activities on non-Federal lands are subject to NEPA if there is a Federal nexus. Since NEPA is a disclosure law, it does not require subsequent minimization or mitigation measures by the Federal agency involved. Although Federal agencies may include conservation measures for whitebark pine as a result of the NEPA process, any such measures are typically voluntary in nature and are not required by the statute. As NEPA does not provide any regulatory mechanisms, it does not directly address or alleviate the threats of the environmental effects resulting from climate change, white pine blister rust, mountain pine beetle, or fire suppression.

National Forest Management Act of 1976

Under the National Forest Management Act (NFMA) of 1976, as amended, (16 U.S.C. 1600,1614), the USFS manages National Forest lands based on multiple-use, sustained-yield principles, and implement resource management plans to provide for a diversity of plant and animal communities. As such, individual forests may identify species of concern that are significant to each forest's biodiversity. The USFS recognizes the decline of *whitebark pine* and is developing various strategies that focus on restoration, including the Pacific Northwest Region's Restoration Strategy, individual forest action strategies (Aubry *et al.* 2008, entire), and the Rocky Mountain Research Station's Report, Range-wide Restoration Strategy for *Pinus albicaulis* (whitbark pine),(Keane *et al*. 2012, entire). The latter report may provide the most effective rangewide restoration strategy available because it integrates the genetics, pathology, and ecology of whitebark pine.

The USFS also implements whitebark pine restoration and management activities (stand thinning, pruning, fire management) on non-wilderness lands, although whitebark pine forests are generally not accessed for commercial forestry commodity extraction and, therefore, tend to be excluded from most stand improvement actions. The USFS has, along with university researchers and others, made important strides in understanding the white pine blister rust pathosystem and mountain pine beetle life history, researching and propagating rust-resistant whitebark pine seeds and seedlings, and developing strategic plans. Their efforts are encouraging and may provide some benefit to the species at local scales, but these efforts under the NFMA do not directly address or alleviate the threats from the environmental effects resulting from climate change, white pine blister rust, mountain pine beetle, or fire suppression at the rangewide level of the species.

Forest Service Policy

As of July 27, 2011, the USFS Region 2 and Region 4 policy, as established in the Forest Service Manual 2670 Supplement, states species identified as candidates are automatically placed on the sensitive species list (FSM 2672.11(1)) (Houston 2012, pers. comm.; Jacobson 2012, pers. comm.). Region 1 has also included whitebark pine on their sensitive species list since the end of 2011 (Shelly 2012, pers. comm.). Forest Service policy requires review of programs and activities through a Biological Evaluation (BE) to determine potential effects of projects to sensitive species. Decisions must not result in loss of species viability or create a significant trend towards federal listing (FSM 2670.32). BEs must include an evaluation of effects of proposed management actions on whitebark pine or its habitat occurring within an analysis area.

National Park Service Organic Act of 1916

The NPS Organic Act of 1916 (16 U.S.C. 1 *et seq*.) as amended, states that the NPS shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations to conserve the scenery and national and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. Where whitebark pine occurs in National Parks, the NPS Organic Act directs the NPS to address whitebark pine and its health. As such, the NPS has made considerable efforts to survey and monitor whitebark pine stands and identify white pine blister rust infection levels. While the NPS makes certain that natural processes will occur, such as natural whitebark pine regeneration, they may actively intervene when natural ecological processes are not adequately functioning. In the case of whitebark pine, intervention could include restoration actions, and these actions would likely mimic criteria provided under the Wilderness Act (Reinhart 2011, pers. comm.). While the NPS Organic Act directs the NPS to address whitebark pine health, it does not provide mechanisms that directly address or alleviate the threats from the environmental effects associated with climate change, white pine blister rust, mountain pine beetle, or fire suppression.

Clean Air Act of 1970

As explained under Factor A, warming temperatures are expected to result in direct habitat loss and have also caused increases in populations of the predatory mountain pine beetle resulting in significant mortality rangewide. The Clean Air Act of 1970 (42 U.S.C. 7401 *et seq*.), as amended, requires the Environmental Protection Agency (EPA) to develop and enforce regulations to protect the general public from exposure to airborne contaminants that are known to be hazardous to human health. In 2007, the Supreme Court ruled that gases that cause global warming are pollutants under the Clean Air Act and that the EPA has the authority to regulate carbon dioxide and other heat-trapping gases (*Massachusetts et al*. v. *EPA 2007* [Case No. 05,1120]).

The EPA published a regulation to require reporting of greenhouse gas emissions from fossil fuel suppliers and industrial gas suppliers, direct greenhouse gas emitters, and manufacturers of heavy-duty and off-road vehicles and engines (74 FR 56260; October 30, 2009). The rule, effective December 29, 2009, does not require control of greenhouse gases; rather it requires only that sources above certain threshold levels monitor and report emissions. On December 7, 2009, the EPA found under section 202(a) of the Clean Air Act that the current and projected concentrations of six greenhouse gases in the atmosphere threaten public health and welfare. EPA's finding itself does not impose requirements on any industry or other entities, but is a prerequisite for any future regulations developed by the EPA. At this time, it is not known what regulatory mechanisms will be developed in the future as an outgrowth of EPA's finding or how effective they would be in addressing climate change. Therefore, the Clean Air Act and its existing implementing regulations do not currently provide regulatory mechanisms relevant to threats from the environmental effects associated with climate change, and the synergistic interactions with white pine blister rust, mountain pine beetle, or fire suppression.

Federal Wildland Fire Management Policies, Plans, and Guides

A variety of Federal fire management policies, plans, and implementation guides have been developed to both standardize interagency procedures and provide for a full spectrum of fire management options, including suppression and allowing some fires to function in their natural ecological role. Federal Land and Resource Management Plans also incorporate fire management, including use of prescribed fire, and typically provide more detailed guidance for individual agency units, such as a National Forest. These planning and implementation documents have the potential to benefit the species. However, these documents are typically broad in scope allowing a wide degree of latitude in potential fire management actions. We do not have information to indicate that fire management policies are currently being used in a way that alleviates the threat of fire suppression rangewide or contain fire use prescriptions that could protect whitebark pine. Therefore, at this time we conclude that current fire management policies are inadequate to reduce or eliminate the threat of fire suppression across the entire range of whitebark pine.

State Laws and Regulations

Whitebark pine generally has not been tracked by State wildlife or natural heritage programs in States where the species occurs. NatureServe's last status review revision of whitebark pine (November 2011) ranked it as a G3/G4 species, which means the species is vulnerable across its entire range (NatureServe 2015, no pagination). State rankings include Idaho (S4, apparently secure), Montana (S2, imperiled), Oregon (S4), and Wyoming (S3, vulnerable). Washington, California and Nevada have not ranked the species and are under review (NatureServe 2015, no pagination). However, these rankings do not grant whitebark pine any special status under any State legislation (NatureServe 2015, no pagination)). The individual State rankings of S4 (apparently secure) are contrary to what the most current data suggest, that is, that whitebark pine is declining rangewide. A very minimal amount of the whitebark pine range is known to occur on State lands. We do not know of any existing State laws or regulations that address or alleviate impacts from white pine blister rust, mountain pine beetle, or fire suppression. Additionally, we are not aware of any State laws or regulations that address the environmental effects resulting from climate change.

Canadian Federal and Provincial Laws and Regulations

The Committee on the Status of Endangered Wildlife in Canada designated whitebark pine as Endangered under the Canadian Species at Risk Act (SARA) on June 20, 2012, due to the high risk of extirpation (Achuff 2012, pers. comm.). This listing provides protection from harming, killing, collecting, buying, selling or possessing, for individuals on federal land (Achuff 2012, pers. comm.). However, it applies only to Federal lands, and most of whitebark pine's distribution in Canada occurs on non-Federal lands (most public lands, or Crown lands, are under provincial jurisdiction) (Achuff 2012, pers. comm.). Alberta, Canada has completed a Recovery Plan for 2013-2018 to focus on conserving existing populations of whitebark pine and habitat while restoring populations across its current and historical provincial range in sufficient numbers to continue functioning in its ecological role. This plan is meant to supplant a national recovery strategy in Canada (Alberta Whitebark and Limber Pine Recovery Team 2014, p. vii). We have no further information on a national recovery plan in Canada. Some whitebark pine habitat is currently protected in national parks and provincial protected areas, but most habitat lies outside of these (Achuff 2012, pers. comm.).

At the provincial level, in Alberta and British Columbia, Canada, whitebark pine is currently ranked as S2 (imperiled) (NatureServe 2015, no pagination) and assessed as Endangered under the

Alberta Wildlife Act, and and blue-listed (species of special concern) (Wilson 2007, p. 1; Environment Canada 2010, p. 71; COSEWIC 2010, p. 30). However, these rankings and assessments do not provide legal protections and only suggest voluntary conservation measures. Parks Canada has initiated conservation efforts including monitoring, prescribed fire, white pine blister rust-resistant tree identification, seed collection, and use of pheromones to protect apparent blister rust-resistant trees from mountain pine beetle attack (Wilson 2007, pp. 12Ã¢â‚¬â€œ13). The provincial designations likely benefit the species and raise public awareness; however, they provide no legal protections, as conservation measures are largely voluntary.

In summary, we examined a number of existing regulatory mechanisms that have the potential to address current and projected threats to whitebark pine populations. The majority of whitebark pine habitat in the United States occurs on Federal lands, where Federal agencies have broad regulatory authority to plan and manage land use activities, including timber harvest, recreation, and a variety of other actions. Some management activities have the potential to benefit whitebark pine and its habitat. However, in our review of existing regulatory mechanisms, only the policies related to Federal Wildland Fire Management Policies, Plans, and Guides directly address any of the four main threats to the species identified in this document. Specifically, these policies have the potential to reduce or eliminate threats to whitebark pine from fire suppression. However, at this time we find that these policies are inadequate to address this threat.

The existing regulatory mechanisms currently in place throughout the range of whitebark pine are inadequate to reduce or eliminate any of the four main threats to the species identified above, the loss of habitat from fire suppression and the exacerbating environmental effects of climate change under Factor A, and mortality from white pine blister rust and mountain pine beetle under Factor C. Therefore, based on our review of the best scientific and commercial information available, we conclude that existing regulatory mechanisms are inadequate to protect whitebark pine or its habitat.

E. Other natural or manmade factors affecting its continued existence:

We did not identify any other natural or manmade factors that are likely to pose a threat to the existence of the species. Therefore, we conclude that the best scientific and commercial information available indicates that whitebark pine is not threatened by other natural or manmade factors affecting its continued existence.

Conservation Measures Planned or Implemented :

Most current management and research focuses on producing whitebark pine with inherited resistance to white pine blister rust. Additional research investigates natural regeneration and silvicultural treatments, such as appropriate site selection and preparation, pruning, and thinning in order to protect genetic resources, increase reproduction, reduce blister rust damage, and increase stand volume (Zeglen *et al*. 2010, p. 361). Genetic management of white pine blister rust is actively conducted for whitebark pine (Mahalovich 2015). Cone collections are used for blister rust resistance testing, molecular genetics studies, other research, growing compatible rootstock for seed orchards, clone banking, breed orchard grafting, and gene conservation (Mahalovich 2015). Recent whitebark pine cone collections in Idaho could restore from 985 ha (2,435 ac) up to 2957 ha (7,307 ac) (Mahalovich 2015). Efforts are underway to coordinate natural regeneration monitoring (Mahalovich 2015). Four concurrent blister rust screenings are occurring at Coeur d Alene Nursery in Idaho with 108,744 seedlings (Mahalovich 2015). For all of 2014, approximately 619 ha (1,531 acres) of whitebark pine seedlings were planted among three USFS Regions (Mahalovich 2015). Overall, since 1988, 2278 ha (5,630 ac) have been planted with rust resistant seedlings among the 3 Regions (Shelley 2015, pers. comm.).

Specific to the USFS Northwest Region (Oregon and Washington), accomplishments for whitebark pine restoration during 2014 include: (1) Approximately 3,000 whitebark pine seedlings were planted on four forests; (2) Whitebark pine cones were collected from 59 individual trees for gene conservation and rust screening; (3) 20 ha (50 ac) of forested stands were treated by thinning to reduce competing vegetation; (4) Application of verbenone and interpretive sign installation was done (Bower 2015, pp. 2). In addition, aerial detection surveys were conducted in 2014 to fly the entire region to map forest disturbances of the forested lands regardless of ownership (Bower 2015, pp. 6-7). Aerial surveys mapped 1,687 ha (4,170 ac) of mortality in whitebark pine attributable to mountain pine beetle (Bower 2015, pp. 7). This number was down from 2013, which had 2,384 ha (5,891 ac) of mortality mapped (Bower 2015, pp. 7). There were an estimated 9,049 trees killed in 2014, down from 10,503 trees in 2013 (Bower 2015, pp. 7). The majority of the detectable damage over 2013 and 2014 has been on the Deschutes National Forest and primarily within the Newberry National Monument, which is the only area that has shown a noticeable increase in acreage affected (Bower 2015, pp. 7). Overall, mountain pine beetle mortality across the Region has declined over the past few years (Bower 2015, pp. 7).

The USFS Northern Region (Rocky Mountain area) initialized a range-wide restoration strategy for whitebark pine forests (Keane *et.al*. 2012). The objectives are to promote whitebark pine survival and regeneration for ecological diversity, wildlife, hydrologic and other benefits through the use of planned and unplanned ignitions (Keane *et.al.* 2012). The strategy contains guiding principles, central tenets for a strategy and assessment criteria for future planning (Keane *et.al.* 2012). The USFS Northern Region continues to collect whitebark pine seeds on 186 ha (461 ac) on 7 Forests for future plantings and to conduct whitebark pine blister rust screenings (Shelly 2105, pers. comm).

The objectives for modeling efforts for the distribution and extent of whitebark pine are to create a comprehensive set of methods to produce GIS products that map current whitebark pine extent, current potential range, and suitable regeneration areas, implement these methods to create the GIS map products for the Flathead National Forest, and conduct a field validation of the Flathead National Forest GIS map products (Housman 2014, pers. comm.). These validated single-species map products will guide management decisions for restoration projects, fire management activities, and ESA compliance within the Flathead National Forest. These products were expected to be complete in 2014 (Housman 2014, pers. comm.), however we have no updated information to include in this document.

The BLM continues to institute various programs for the conservation of whitebark pine. In Wyoming, 60 ha (150 ac) of competing conifers were removed in whitebark pine stands and whitebark pine surveys were conducted in 2013 and 2014 in western Wyoming, and these surveys documented infestations of blister rust and mountain pine beetle in some areas (Means 2015). BLM in Wyoming is currently working to complete an Environmental Assessment, which will lay the ground work for whitebark pine projects that BLM is planning to complete in 2015 as part of their whitebark pine conservation strategy document (Means 2015).

The Greater Yellowstone Whitebark pine Monitoring Working Group continues their monitoring program in the Greater Yellowstone Area which imparts meaningful ground-based information to the broader regional assessment of whitebark pine (The Greater Yellowstone Whitebark pine Monitoring Working Group 2014b, pp.2). The monitoring program acts as an important resource for a variety of organizations embarking on five-needle pine monitoring and has provided insights into past and ongoing research endeavors (The Greater Yellowstone Whitebark pine Monitoring Working Group 2014b, pp.2). Through sustained implementation of the monitoring program, there will be a continuing effort to document and quantify whitebark pine forest dynamics during insect, pathogen, fire, and other climatic events in the Greater Yellowstone Ecosystem.

Summary of Threats :

The primary threat to the species is from disease (Factor C) in the form of the nonnative white pine blister rust and its interaction with other threats. We found that white pine blister rust is now nearly ubiquitous throughout the range of whitebark pine. White pine blister rust results in the mortality of an overwhelming majority of infected individuals, and all age classes of trees are susceptible. Seedlings are killed rapidly, and while some mature individuals may persist on the landscape for decades following infection, white pine blister rust typically kills seedcone-bearing branches. White pine blister rust has impacted millions of acres (hectares) of whitebark pine. Currently, colder, drier areas of the range that were originally thought to be less susceptible to the disease are now showing considerable rates of infection. Based on current mortality rates, the estimated population decline for the northern 56 percent of the range (i.e., Canada), is expected to be 57 percent within 100 years, which is less than two generations for this species (COSEWIC 2010, pp. viii, 19). However, that is likely an underestimate, as it assumes current mortality rates remain constant.

After examining information collected on the incidence of white pine blister rust, we conclude that white pine blister rust will continue to intensify and kill whitebark pine throughout its entire range. The remainder of the range (i.e., United States) is experiencing similar rates of mortality, and thus we anticipate a decline similar to that estimated for the northern portion of the range (Canada). small percentage of genetic resistance to white pine blister rust is present in whitebark pine *o*n the landscape, and research is currently being conducted to identify and propagate resistant individuals. However, these programs are still in the early stages and an effective breeding program could take decades.

Mountain pine beetle predation is no longer occurring at an epidemic level. Although no longer causing the high levels of mortality that were seen in recent years, mountain pine beetle epidemics are cyclical, and given climatic conditions that are increasingly favorable to the beetle, we anticipate future epidemics will be more frequent and severe. Because the current beetle epidemic is subsiding, we expect impacts from synergistic interactions between mountain pine beetle and blister rust to be measurably reduced. Importantly for the persistence of the species, reproductive individuals that show genetic resistance to blister rust now have a higher probability of survival and reproduction in the absence of significant mountain pine beetle mortality.

We anticipate that continuing environmental effects resulting from climate change will result in direct habitat loss (Factor A) for whitebark pine, a high-elevation species occurring only in cool mountaintop habitats. Bioclimatic models predict that suitable habitat for whitebark pine will decline precipitously within the next 100 years. Research indicates that northern migration of whitebark pine is a possible, but unlikely, response to the projected rate of warming climatic conditions. Additionally, the presence of white pine blister rust on the northern portions of the range could potentially impede effective migration. Adaptation to a rapidly warming climate also seems unlikely for a species that has an estimated generation time of 60 years.

We also anticipate that continuing environmental effects resulting from climate change will result in direct habitat loss (Factor A) for whitebark pine, a high-elevation species occurring only in cool mountaintop habitats. Bioclimatic models predict that suitable habitat for whitebark pine will decline precipitously within the next 100 years. Research indicates that northern migration of whitebark pine is a possible, but unlikely, response to the projected rate of warming climatic conditions. Additionally, the presence of white pine blister rust on the northern portions of the range could potentially impede effective migration. Adaptation to a rapidly warming climate also seems unlikely for a species that has an estimated generation time of 60 years.

Past and ongoing fire suppression is also negatively impacting populations of whitebark pine through direct habitat loss (Factor A). Many stands of trees once dominated by whitebark pine are now dense stands of shade-tolerant conifers. This change in forest structure and composition facilitates an increased frequency and intensity of wildfire and an increased susceptibility to predation and disease. Additionally, environmental changes resulting from changing climatic conditions are acting alone and in combination with the effects of fire suppression to increase the frequency and severity of wildfires. Whitebark pine could potentially regenerate following even stand-replacing wildfires, if a seed source is available. However, widespread predation and disease currently impacting whitebark pine are limiting available seed sources, making the probability of regeneration following wildfire less likely.

In our analysis of Factor D, we examined several Federal mechanisms that could potentially address the threats to whitebark pine. These mechanisms may be useful in minimizing the adverse effects to whitebark pine from potential stressors such as commercial harvest or habitat destruction and degradation from road construction; however, none of these potential stressors rises to the level of a threat to whitebark pine. The existing regulatory mechanisms we examined do not provide adequate protection to whitebark pine from stressors that rise to the level of a threat, including white pine blister rust, mountain pine beetles, the exacerbating effects of environmental change resulting from changing climatic conditions, and fire suppression. Thus, we concluded the existing regulatory mechanisms are inadequate to address the threats presented above.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

We support continuing monitoring efforts across several states by BLM and USFS for the conservation of whitebark pine. The USFS in Region 1 has conducted aerial monitoring for almost 50 years. The valuable information gathered from these surveys includes determining the approximate location and amount of tree mortality, defoliation, and other non-fire damage for whitebark pine. We recommend continuing the aerial surveys and continuing proactive reforestation efforts such as planting of rust-resistant seedlings, prescribed burning and fuels treatments on USFS and BLM managed lands and in Canada across the range of whitebark pine. Various research efforts are ongoing on blister rust and its impacts on whitebark pine in the U.S. and Canada. Most current management and research focuses on producing whitebark pine with inherited resistance to white pine blister rust and genetic management. This research may provide important information in conserving whitebark pine populations in the future.

Priority Table

<table>
<tr><td>Magnitude</td><td>Immediacy</td><td>Taxonomy</td><td>Priority</td></tr>
<tr><td rowspan="6">High</td><td rowspan="3">Imminent</td><td>Monotypic genus</td><td>1</td></tr>
<tr><td>Species</td><td>2</td></tr>
<tr><td>Subspecies/Population</td><td>3</td></tr>
<tr><td rowspan="3">Non-imminent</td><td>Monotypic genus</td><td>4</td></tr>
<tr><td>Species</td><td>5</td></tr>
<tr><td>Subspecies/Population</td><td>6</td></tr>
<tr><td rowspan="6">Moderate to Low</td><td rowspan="3">Imminent</td><td>Monotypic genus</td><td>7</td></tr>
<tr><td>Species</td><td>8</td></tr>
<tr><td>Subspecies/Population</td><td>9</td></tr>
<tr><td rowspan="3">Non-Imminent</td><td>Monotype genus</td><td>10</td></tr>
<tr><td>Species</td><td>11</td></tr>
<tr><td>Subspecies/Population</td><td>12</td></tr>
</table>

Rationale for Change in Listing Priority Number:

Recent monitoring data indicates the current mountain pine beetle epidemic is waning in large areas across the range of whitebark pine (Shelly 2014, pers. comm.; Hayes 2013, p. 3, 39, 41, 42, 54; Bower 2014, p. 2), as detailed in Factor C, Disease. As anticipated, a significant reduction in the number of available host trees has resulted in the ongoing return to endemic or natural levels of mountain pine beetle; millions of whitebark pine and other susceptible pine trees have experienced beetle mortality (Shelley 2015, pers.comm). The subsidence of the current mountain pine beetle epidemic results in a decreased probability of predation and importantly a decrease in the synergistic impacts of predation and disease. In our 2011 finding and all subsequent CNORs, we indicated this synergistic interaction was a threat to the persistence of this species; by definition, the total effect of the synergistic interaction between these two threats is greater than the sum of the individual effects. Specifically of concern, the small percentages of whitebark pine that are genetically resistant to white pine blister rust are still vulnerable to mountain pine beetle attack, but the waning of the current mountain pine beetle epidemic increases the chances of those resistant individuals surviving. Genetic resistance to white pine blister rust is critical to species persistence given there is no known way to control, reduce or eliminate the non-native pathogen at this time, particularly at the landscape scale needed to effectively conserve this species. The identification and propagation of such genetically resistant individuals has been an important focus of conservation efforts and likely will be key to species recovery in the future.

The significant threat from white pine blister rust remains on the landscape as blister rust continues to spread and occurs in all parts of the range, and is still an imminent threat. As mentioned in detail above (Factor C, Synergistic Interactions Between Disease and Predation) white pine blister rust and mountain pine beetle have acted both cumulatively and synergistically to pose a threat to whitebark pine rangewide. The magnitude of cumulative and synergistic impacts have been reduced following changes in pine beetle predation and this provides the basis for our change from an LPN of 2 to 8.

Magnitude:

The current threat of mountain pine beetle mortality to whitebark pine is low in magnitude at this time; recent monitoring data demonstrates the current mountain pine beetle epidemic is waning. However, we recognize that the magnitude of this threat may increase in the future. The decline in current pine beetle predation rates decreases the magnitude of cumulative and synergistic impacts from predation and disease. Thus, fewer trees are expected to exhibit combined disease and predation mortality. As a result, we consider the threat from blister rust to be relatively more moderate at this time. However, we recognize that although the threat from blister rust has been ameliorated somewhat with the waning beetle epidemic, it remains a substantial threat to whitebarkpine, occurring throughout all of the range of whitebark pine except for the interior Great Basin, which accounts for only 0.4 percent of whitebark pine distribution in the United States. The incidence of white pine blister rust is highest in the Rocky Mountains of northwestern Montana and northern Idaho, the Olympic and western Cascade Ranges of the United States, the southern Canadian Rocky Mountains, and British Columbia Coastal Mountains. Trends strongly indicate that white pine blister rust infections have increased in intensity over time and are now prevalent in even drier and colder areas originally considered less susceptible to infection. Based on updated survey information, blister rust maintains a significant presence across the species range and whitebark pine infection rates continue to increase in the Canadian Rockies. Based on current information discussed in detail in the threats analysis, we expect these threats to continue to impact whitebark pine into the foreseeable future. Overall, the magnitude of threat to the species is moderate.

Imminence :

The threats of rangewide disease, fire and fire suppression, and environmental effects of climate change are imminent because they are affecting whitebark pine currently, and are expected to continue and likely intensify in the foreseeable future. As stated above, the most recent mountain pine beetle epidemic is subsiding; therefore we do not consider that threat to be imminent at this time. We also determined that regulatory measures (Factor D) across the range of whitebark pine are inadequate to protect the species from immediate and long-term impacts from other threats identified in Factors A and C. These actual, identifiable threats are covered in detail under the discussion of Factors A and C, and currently include mortality from white pine blister rust, predation by mountain pine beetle, fire and fire suppression, and environmental effects of climate change.

Trends indicate that these threats are currently having a significant negative impact on whitebark pine throughout its range. Attempts to control white pine blister rust and mountain pine beetle have been ineffective, and we believe the threats will have increasingly negative impacts on whitebark pine into the foreseeable future. Overall, the threats to the species are imminent.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

After re-analyzing the threats to whitebark pine, we have determined that emergency listing the species is not warranted. The threat of mountain pine beetle mortality to whitebark pine has decreased and is low in magnitude. Further, the threat from synergistic impacts of mountain pine beetle and blister rust is lessened. However, other major threats (disease, environmental changes and exacerbating effects of climate change, fire and fire suppression) occur throughout all of the species range and are having a demonstrable effect on the species. The primary threat, white pine blister rust, is of moderate magnitude, occurring throughout all of the range of whitebark pine except for the interior Great Basin, which accounts for only 0.4 percent of whitebark pine distribution in the United States. For this reason, we find that changing the current listing priority number (LPN 2) to LPN 8 is appropriate and an emergency listing is not warranted.

Description of Monitoring:

The USFS Region 1 conducts aerial detection surveys annually to determine the approximate location and amount of mountain pine beetle tree mortality, defoliation, and other non-fire damage. These surveys have been conducted for nearly 50 years, although procedures have varied during that time. Aerial survey results from 2000-2013 show whitebark pine mortality, which spiked to its highest level in 2009, and has declined since (Shelley 2014, pers. comm.).

Since 2004, an interagency working group (USFS, US Geological Survey, National Park Service, Montana State University, Greater Yellowstone Coordinating Committee) effort has resulted in a monitoring protocol and a complete sampling frame of data. The objectives of the whitebark pine monitoring program are to detect and monitor changes in the health and status of whitebark pine populations across the greater Yellowstone ecosystem due to infection by white pine blister rust, attack by mountain pine beetles, and damage by other environmental and anthropogenic agents. Their current report presents a summary of the data collected between 2008 and 2013 (Greater Yellowstone Whitebark pine Monitoring Working Group, 2014).

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

California,Montana,Oregon,Wyoming

Indicate which State(s) did not provide any information or comment:

Nevada,Washington

State Coordination:

Montana, Wyoming, Oregon, Idaho, California, Utah, and British Columbia, Canada all provided information.

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: 05/27/2015
Date

Concur: 12/15/2015
Date

Did not concur:
Date

Director's Remarks: